

Kaon Sections

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Thank you Tom for your countless years
of service and leadership !!!

News since last RPP Update

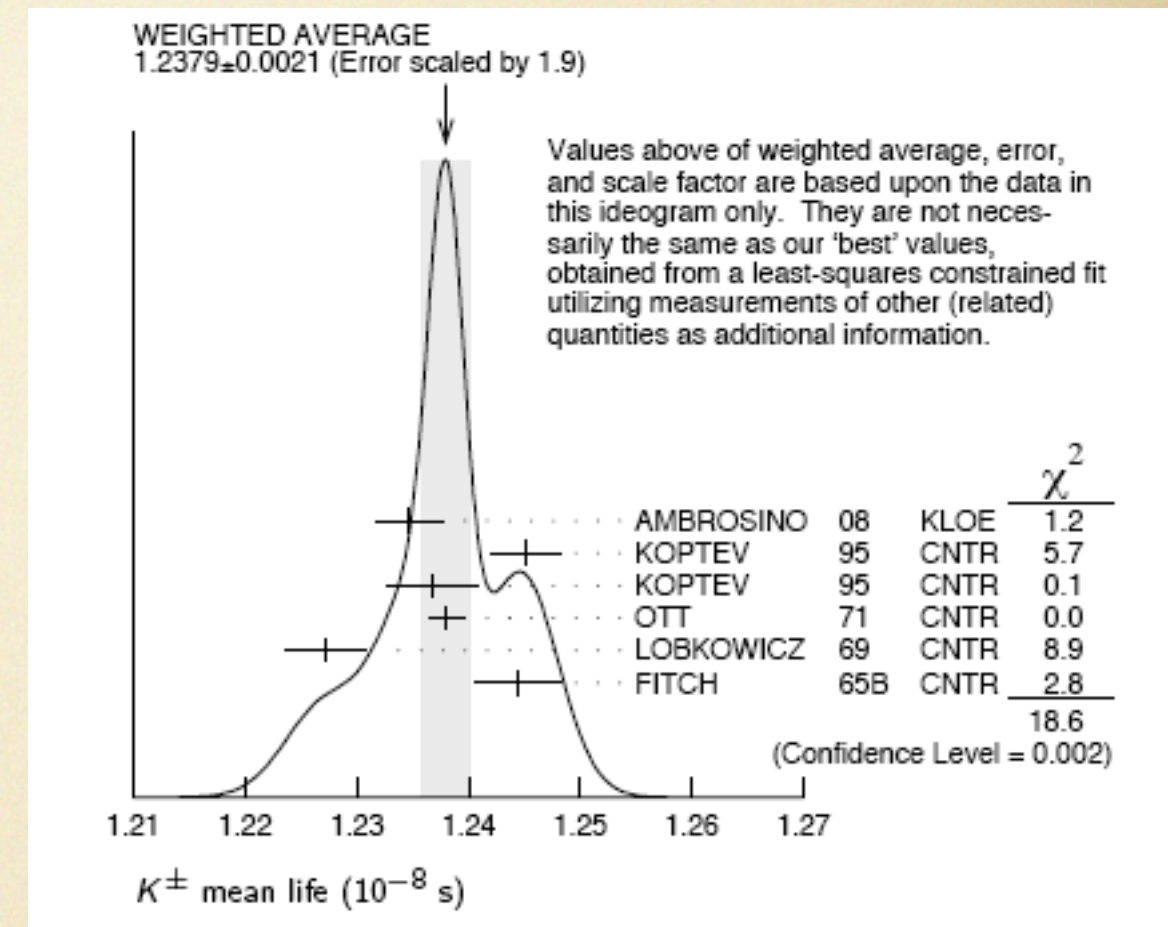
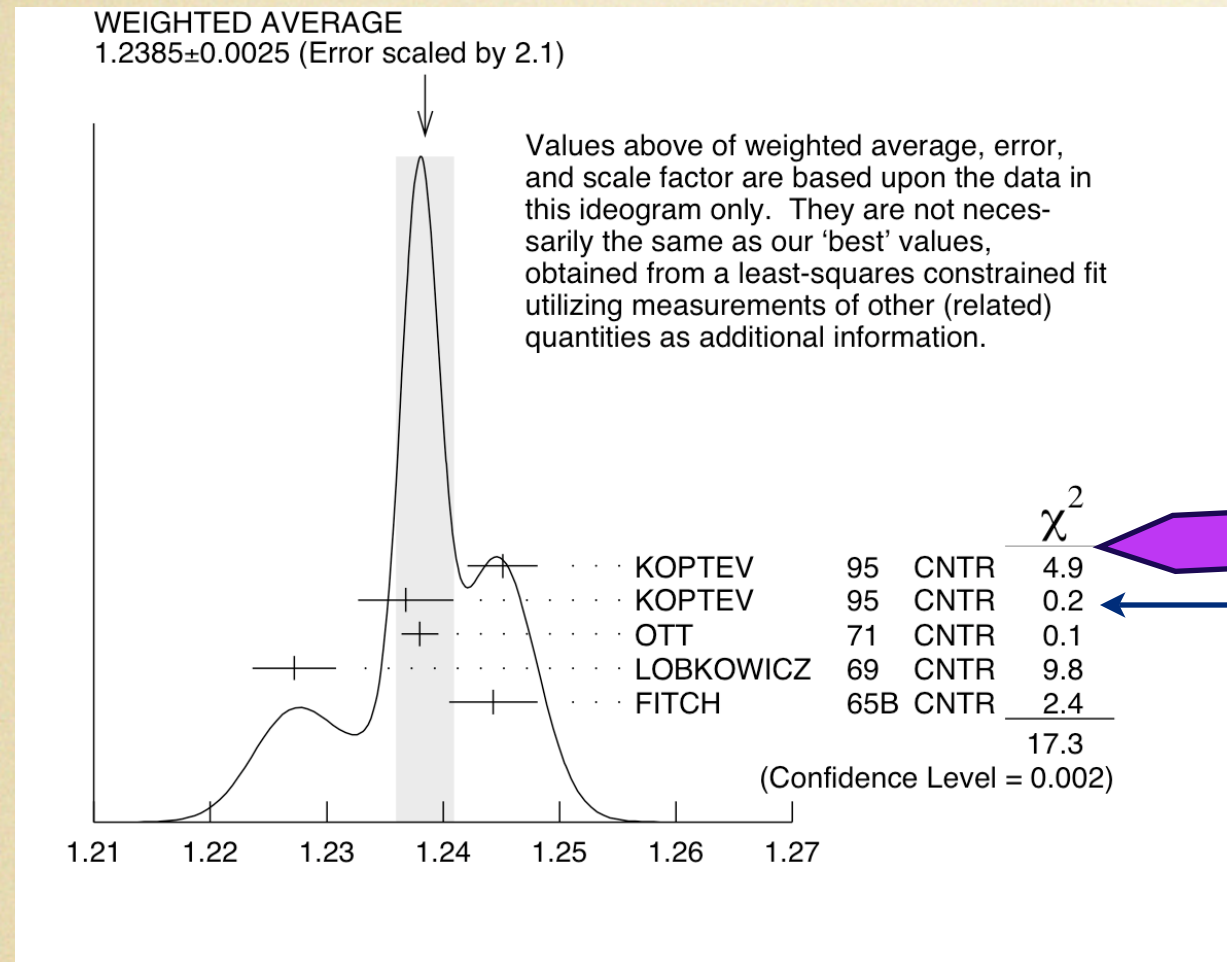
- Reviewed ~40 publications
- Encoded ~100 measurements including new form factor parametrizations
- New mini-review on CPT invariance test
- Updated mini-reviews

Theoretical Emphasis in Kaon

(Experimental issues covered in C.-J. Lin's talk tomorrow)

- K^+ lifetime (Franzini questions)
- V_{us} status / Simon questions
- Other ff problems ($K_L \rightarrow e^+ e^- \gamma$,
 $K_L \rightarrow \mu^+ \mu^- \gamma$)
- More complete fit K^0 / K_S

K⁺ lifetime



- Ott 71 4 runs: statistical err. averaged!
0.0016 10⁻⁸ s (twice larger?)

- Koptev 95: from two different measurements / targets

- $\tau(\text{Cu}) = 1.2368 \pm 0.0041 \text{ ns}$



1.2451±0.0030 ns ?

- $\tau(\text{U}) = 1.2451 \pm 0.0030 \text{ ns}$

Measurements not consistent!
KLOE suspects older meas may have underestimated syst. uncertainties

$K \rightarrow \pi l \nu$ and CKM unitarity

$$|V_{ud}|^2 + |V_{us}|^2 + |V_{ub}|^2 = 1 \quad V_{ub} \text{ negligible}$$

- Superaligned transitions $\Rightarrow |V_{ud}| = 0.9738 \pm 0.0003 \xRightarrow{\text{Unit.}}$

$$|V_{us}|^{\text{Unit.}} = 0.2275 \pm 0.0012$$

$$|V_{us}|^{\text{PDG04}} = 0.2196 \pm 0.0026$$

Leutwyler, Roos

$$|V_{us}|^{\text{PDG06}} = 0.2257 \pm 0.0021$$

$$|V_{us}|^{\text{PDG08*}} = 0.22461 \pm 0.00048$$

All K's

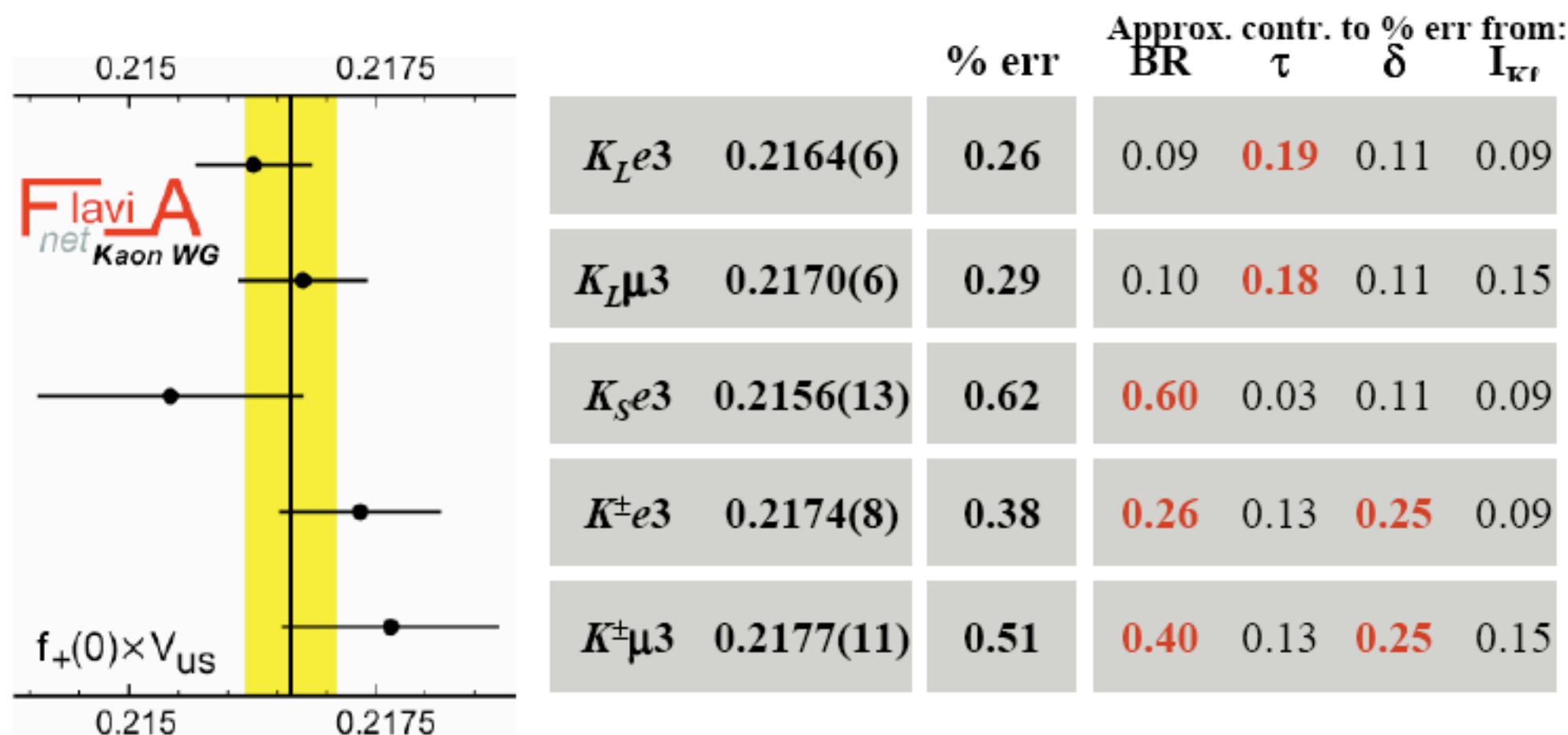
Recent data on V_{us} agree with $V_{us}^{\text{Unit.}}$

$$\Gamma(K_{l3}^i) = \mathcal{N}_i |V_{us}|^2 |f_+(0)|^2 (1 + \delta_{rad}^l) I(\lambda_+, \lambda_0)$$

- Kaon revolution in 2004-2005: BNL E865, ISTRA, KTeV, NA48, KLOE $\Gamma(K_{l3}^i)$ all increased by 6% All Major KL BRs Changed! ϵ_K changed by 3.7σ
- After 06 NA48, KLOE improvements in semileptonic BRs
- NA48, KLOE $R_K = \Gamma(K_{e2})/\Gamma(K_{\mu2})$
- Better understanding theoretically of the form factor $f_{+,0}(t) = f_+(0)(1 + \lambda_{+,0}t/m_\pi^2)$ linear \rightarrow quadratic \rightarrow pole \rightarrow dispersive approaches
- Blucher Marciano review the actual status in PDG08

Determination of $|V_{us}| \times f_+(0)$

$$\Gamma(K_{l3}(\gamma)) = \frac{C_K^2 G_F^2 M_K^5}{192\pi^3} S_{EW} |V_{us}|^2 |f_+^{K^0\pi^-}(0)|^2 I_{Kl}(\lambda_{+,0}) (1 + \delta_{SU(2)}^K + \delta_{em}^{Kl})^2$$



Average: $|V_{us}| f_+(0) = 0.2167(5)$ $\chi^2/\text{ndf} = 2.83/4$ (59%)

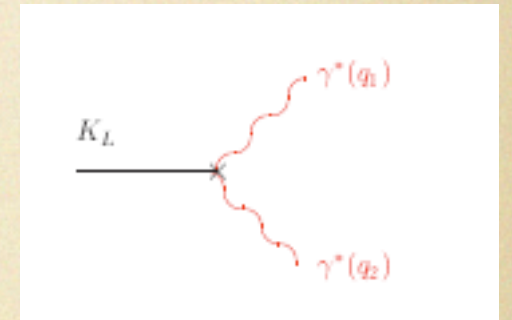
S. Eidelman's concern

While performing a literature search for PDG, I have been picking up for years results on V_{ud}/V_{us} and sending them to LBL. Since there was not a special code for them, I usually grouped them with the main subject of the paper, e.g., kaon, writing S010, V_{us} . Then it would go to Tom Trippe and he would either pay attention or not to this addendum. Even worse was the case when V_{us} was extracted in some phenomenological paper. Then with a large probability it would be thrown away without any serious consideration. My suggestion is to have better classification than now with more codes, so that all relevant papers will be kept in some special "box", which will be visited by overseers and review authors as a "must". Of course, after that they will be free to decide what to do with this or that paper.

- Other ff : $K_L \rightarrow e^+ e^- \gamma$, $K_L \rightarrow \mu^+ \mu^- \gamma$, $K_L \rightarrow \mu^+ \mu^- e^+ e^-$

- Relevant to uncover short distance to $K_L \rightarrow \mu^+ \mu^-$

- Expts measure two ff's **DIP** and **BMS**



DIP

$$A(K_L \rightarrow \gamma^* \gamma^*) = A_{\gamma\gamma}^{\text{exp}} \left[1 + \alpha \left(\frac{q_1^2}{q_1^2 - M_V^2} + \frac{q_2^2}{q_2^2 - M_V^2} \right) + \beta \frac{q_1^2 q_2^2}{(q_1^2 - M_V^2)(q_2^2 - M_V^2)} \right]$$

- We have different encodings for the different channels: however if we assume lepton univ. we could have a fit form all the channels

More Complete K0 / KS / KL Global Fits

- In the K0 Section we have several encodings of $\Delta S = \Delta Q$ tests ($\text{Im}(x_+)$, $\text{Re}(x_+)$, ...) from NA48, CPLEAR, KLOE
- These encodings require inputs from KL and KS sections
- It would then be desirable to have a Kaon Global fit
- This is one example but there are many other cases which also would benefit from Global fits (see Cheng-Ju talk tomorrow)

My conclusions

- Where is a nice place to encode $\pi\pi$ scattering lengths? Nice data from NA48 in $K \rightarrow 3\pi$
- Welcome to Cheng-Ju Lin and thanks to Flavianet people for productive discussions